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Hospitalised patients with unexplained chest pain: incidence and prognosis

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Abstract. Egeland GM, Akerkar R, Kvåle R, Sulo G, Tell GS, Bakken IJ, Ebbing M (Norwegian Institute of Public Health; University of Bergen; Haukeland University Hospital, Bergen, Norway). Hospitalised patients with unexplained chest pain: incidence and prognosis. *J Intern Med* 2019;https://doi.org/10.1111/joim.12948

Background. The prognosis of unexplained chest pain patients provides valuable information for evaluation of health services.

Objective. To examine prognosis of unexplained chest pain.

Methods. Using data from in- and outpatient hospital visits in Norway of patients discharged with a main diagnosis of unexplained chest pain (ICD-10: R072–R074) in 2010–2012, the 1-year incidence of coronary heart disease (CHD), any cardio-vascular disease (CVD) and mortality was evaluated. Cases with prior 2-year history of CVD or chest pain were excluded. Cox proportional hazards evaluated outcomes by patient characteristics and standardized mortality ratios evaluated observed versus expected mortality.

Results. Of 59 569 patients identified (20–89 years of age), the majority (86%) were referred to hospital by out-of-hours emergency care centres. Subsequent CHD was noted for 12.5%, 19.5% and 25.0% of men and 7.2%, 11.0%, 14.0% of women aged 45–64, 65–74 and 75–89 years, respectively. The per cent of deaths attributed to CVD were greatest within the first 2 months of postdischarge. Total mortality rates (per 1000 person-years) were 6.6 in men and 4.7 in women aged 45–64 and 69.2 in men and 39.5 in women aged 75–89 years. Relative to the general population, mortality was 53% and 45% higher for men and women under 65 years of age, respectively, attributed primarily to non-CVD causes.

Conclusion. Patients in Norway discharged with unexplained chest pain are an at-risk group in terms of incident CHD, any CVD and mortality, including non-CVD mortality during the first-year postdischarge. The results suggest that unexplained chest pain patients may benefit from greater healthcare coordination between medical disciplines.

Keywords: cardiovascular disease, chest pain, incidence, mortality, socio-economic status.

Introduction

Chest pain is a common adult symptom [1–4], and patients presenting with chest pain represent a significant burden to emergency departments [5]. In the US, chest pain accounted for 38% of noninjury emergency department visits between 2007 and 2008 where acute coronary syndrome was identified for only 13% of the patients with chest pain [6]. The primary concern for practitioners has been identifying underlying coronary heart disease (CHD) and preventing life-threatening events such as myocardial infarction. Excessive diagnostic procedures, on the other hand, incur costs and utilize the time of healthcare personnel [7]. Chest pain in 40% of patients [8] or more [9,10] indicates the presence of noncardiac causes [11–15], primarily reflecting gastro-oesophageal disorders, psychological distress/anxiety and respiratory disease.

The evaluation of the prognosis of patients with chest pain can provide valuable insight of the healthcare needs of this patient group and help guide the planning of healthcare services. We, therefore, evaluated the 1-year morbidity and mortality of patients discharged from hospital with an incident diagnosis of unexplained chest pain in

Norway. Further, we compared 1-year mortality of the patient population to that of the general population.

Materials and methods

The study is a component of the research project, 'Patients with Cardiovascular Disease in Norway, 2008–2012' approved by Region North (2012/1005) of the Regional Committees for Medical and Health Research Ethics.

Patients

Patients discharged from hospital or outpatient clinics with a main diagnosis of unexplained chest pain (International Classification of Diseases, ICD-10: R07.2 'Precordial pain', R07.3 'Anterior chest-wall pain NOS' and R07.4 'Chest pain, unspecified') were identified through the 'Cardiovascular Disease (CVD) in Norway 2008-2012' project with details published elsewhere [16]. Data were obtained from the Norwegian Patient Registry, the Cause of Death Registry and the National Educational Database of Statistics Norway. The National Registry provided census data. The Norwegian Patient Registry includes data on hospital inpatient and outpatient visits with information on diagnoses and medical/surgical procedures performed during the hospital visit.

Exclusions

A total of 144 261 patients were identified with a main discharge diagnosis of unexplained chest pain during 2008–2012. We used a 2-year look back period where patients with a prior main or secondary CVD diagnosis (ICD-10: I00–I99; n = 43 666) or an unexplained chest pain diagnosis during 2008–2009 (n = 30 800) were excluded. Further, patients with a secondary diagnosis of unexplained chest pain in 2010–2012 (n = 4284) were excluded from the prospective analyses. In addition, we excluded patients under 20 and over 89 years of age at time of their first hospital discharge with chest pain during 2010–2012 (n = 2245), and patients without a national personal identification number (n = 1831). Finally, those who had a secondary CHD diagnosis noted at the time of discharge with unexplained chest pain as the main diagnosis during 2010–2012 (n = 1866) were excluded. After exclusions, data on 59 569 patients remained for analyses of prognosis (Figure S1, Flow chart). The 59 569 patients provided a maximum of 48 259 person-years of follow-up where the discrepancy in number of patients versus person-years largely reflected unequal lengths of observation time resulting from patients whose first discharge with unexplained chest pain occurred late in the third year of the study period (i.e. they could not contribute a full year of observation).

Outcomes

We evaluated the extent to which patients received diagnostic procedures within 180 days after discharge with unexplained chest pain as the main diagnosis (index event). Procedures were identified through F-coded procedures in a prior version of the NOMESKO Nordic Classification of Medical Procedures (NCMP) involving coronary angiography and echocardiography (https://finnkode.ehelse.no/#ncmpncsp/0/0/0/-1).

We further evaluated the 1-year postdischarge prognosis for the following outcomes: first registered nonfatal or fatal CHD event (ICD-10: I20–I25); first registered nonfatal or fatal CVD event (any ICD-10: I00–I99); and mortality (CHD, any CVD, non-CVD, and total). The discharge date of the index event was used in calculations of time to event.

Covariates

Covariates were measured at the index event and included patients' age, gender, health region of residence (Southeast, West, Mid, and North), type of healthcare delivery (acute versus not acute, inpatient versus outpatient hospital visit), and educational level: primary (grade school), secondary (high school/vocational school), or post-secondary (any college or university).

Statistical analysis

Patient characteristics are reported as percentages, means (standard deviation, SD), or medians (interquartile range, IQR). The incidence of unexplained chest pain among persons with no previously registered chest pain or CVD diagnosis was evaluated by gender and age groups (20–44, 45–64, 65–74, and 75–89 years of age). Cox regression analyses evaluated hazard ratios (HR) for incident (nonfatal or fatal) CHD and any CVD, as well as for mortality (CHD, any CVD, non-CVD and total) in a model containing age (years), gender, education, and acute versus not acute healthcare (model 1).

An additional analysis included model 1 variables and region and type of healthcare (inpatient versus outpatient). Results from model 2 were very similar to those from model 1 and not presented. Time (in days) was converted to decimal points of a year for the Cox analyses (i.e. a mid-year event had a time of 0.5). Schoenfeld tests evaluated Cox proportionality assumptions and proportional hazard plots for selected parameters were inspected. No deviations from proportionality were identified.

Rates of subsequent CHD, any CVD and of CHD mortality, any CVD mortality, non-CVD mortality, and total mortality by age group and gender were evaluated by lifetable analyses. Smoothed hazards of mortality (per 1000 person-years) by time (in months) postdischarge were graphed by educational level and gender, adjusting for age (years).

Standardized mortality ratio

The observed 1-year mortality (CHD, any CVD, non-CVD, and total) of the patient population, 20–89 years of age, was compared to the expected mortality using standardized mortality ratio (SMR) methodology based upon the 3-year (2010–2012) average annual mortality and general population size by gender and 5-year age intervals. The SMR analyses were stratified by gender and age (<65 and ≥65 years).

Supplemental analyses

Supplemental analyses were conducted including all patients discharged 2010–2012 aged 20–89 years (n = 77 158) with a main discharge diagnosis of unexplained chest pain regardless of whether they had a prior 2-year history of discharge with CVD or unexplained chest pain. All other exclusions were the same as those applied to the primary analyses (Figure S1). The supplemental analyses included evaluation of the population-based prevalence of discharge with unexplained chest pain, life table analyses of mortality by age group and gender, and SMR analyses comparing the observed 1-year mortality of patients with that expected based upon general population mortality rates.

STATA 15 (Stata Corp LP, College Station, TX, USA) and R-3.5.1 were used for the analysis of data. Statistical significance was determined by $P \leq 0.05$.

Results

The majority of patients (86%) represented referrals from out-of-hours emergency primary healthcare centres. Up to 2.3% and 2.5% of the general population of men and women, respectively, had an incident episode with a discharge diagnosis of unexplained chest pain. Men (50.6%) and women were nearly equally represented in the patient population, and half of patients (50.2%) were discharged from an in-hospital stay, whereas the rest were discharged from outpatient hospital clinics (Table 1). Any college or university education was noted for 25% of the patient population (Table 1). The geographical distribution of cases was similar to expected given population sizes by health region (data not presented). The secondary diagnoses most often noted at time of discharge were hypertension (I10.0), diabetes mellitus, noninsulin dependent (E11.9), hypercholesterolaemia (E78.0), hypothyroidism, unspecified (E03.9), and included a notation for being 'under medical observation for cardiovascular disease' (ICD-10 Z03.5), in that order.

Incidence of hospital discharge with unexplained chest pain

The incidence of unexplained chest pain as primary discharge diagnosis (per 1000 residents aged 20–89 years) ranged from 11.8 to 23.0 for men and from 8.1 to 25.3 for women. The peak incidence rate of discharge with chest pain was 45–64 years of age for men (light shaded bars) and 65–74 years for women (dark shaded bars; Fig. 1).

One-year follow-up: morbidity

The majority of patients (66.9%) received cardiac diagnostic procedures within 180 days of discharge. One-year outcomes included 13 648 incident CVD cases (of whom 4479 were incident CHD). The mean time to first CHD event (nonfatal or fatal) was 74 days postdischarge, with age and gender differences noted in the per cent experiencing a CHD event. For example, 25% (22.7–27.4) of men and 14% (12.7–15.4) of women aged 75–89 years of age developed CHD (as diagnosis or cause of death) within the 1-year follow-up with lower 1-year postdischarge cumulative incidences observed among the younger age groups (Fig. 2). Compared to CHD, a greater per cent of patients obtained any CVD outcome (diagnosis or as cause of death) within 1-year postdischarge:

Table 1 *Characteristics of patient population with main hospital or outpatient discharge diagnosis of unexplained chest pain, 2010–2012 (N = 59 569)*

	Mean (SD) or %
Age, years	53.1 (14.6)
Age groups	
20–44	28.3
45–64	49.1
65–74	14.7
75–89	7.8
Male, %	50.6
Community emergency clinic referral, %	86.1
Hospitalised for index healthcare visit for unspecified chest pain, %	50.2
Acute care patients among in-patient hospital visits, %	47.5
Acute care patients among out-patient hospital visits, %	26.8
Diabetes[a] as any secondary hospital discharge diagnoses, %	2.1
Hypertension[b] as any secondary hospital discharge diagnosis, %	6.9
Any college/university education, %	25.0

[a]ICD-10 diagnoses: R072–R074 among patients without any registered CVD diagnoses or unspecified chest pain diagnoses registered in the Norwegian Patient Registry during 2008–2009.
[b]ICD-10 diagnoses: E10–E14.
[c]ICD-10 diagnoses: I10–I15.

53.0% of men and 47.6% of women aged 75–89 with lower percentages observed for younger patients (Fig. 2).

One-year follow-up: mortality

A total of 471 deaths occurred within 1 year of which 121 were CVD deaths (including 68 CHD deaths) and 350 were non-CVD deaths (313 attributed to cancer). The total first-year mortality rates (per 1000 person-years) ranged from 1.5 to 39.5 for women aged 20–44 to 75–89 years, and from 2.7 to 69.2 for men from lowest to highest age group, respectively (Table S2). Corresponding rates of CVD deaths ranged from zero to 11.4 for women and from 0.2 to 17.7 for men from lowest to highest age group, respectively.

Differences by sex, education and acute versus nonacute care

Men had an 88% greater risk of incident CHD adjusting for age, education, and acute care (HR 1.88; 95% CI 1.77–2.00) and a 24% greater risk of incident total CVD (age-adjusted HR 1.24; 95% CI 1.20–1.29) compared to women (Table 2). Gender differences were more pronounced for mortality. Men with incident chest pain had a nearly threefold increased risk of CVD mortality and an 87% increased risk of non-CVD mortality compared to women with incident chest pain (Table 2). Patients with primary education had higher CHD and CVD morbidity risk compared to patients with a post-secondary education. But the educational gradients in total CVD and non-CVD mortality were generally stronger than the educational gradient observed for CHD and total CVD morbidity (Table 2). Acute care patients compared to nonacute care patients had only modestly 4%–5% greater hazards of incident CHD and total CVD but a 36% and 28% greater risk of CVD and non-CVD mortality, respectively. Additional adjustment for healthcare type (inpatient and outpatient visits) and health region did not modify the results presented in Table 2.

Hazards of mortality by time postdischarge

For both men and women, hazards of total mortality (per 1000 person-years) were greatest early postdischarge (<2 months) and declined thereafter (Fig. 3). Hazards of mortality by time intervals postdischarge showed a stronger educational gradient in total mortality for women than men. For men, hazards of mortality for secondary and post-secondary education were similar but low compared to the hazards associated with primary education. The per cent of deaths attributed to CVD was greatest in the early postdischarge time period and then began to increase after 6 months postdischarge (Table S1).

Standard mortality ratio

Relative to the general population, total mortality was 53% (SMR 1.53; 95% CI 1.25–1.86) and 45% (SMR 1.45; 95% CI 1.12–1.86) higher for men and women under 65 years of age, respectively, attributed primarily to non-CVD causes (Table 3). For men 65–89 years of age, a 24% higher total mortality was observed relative to expected (SMR 1.24; 95% CI 1.06–1.44). In contrast, no excess mortality was observed relative to expected for older women.

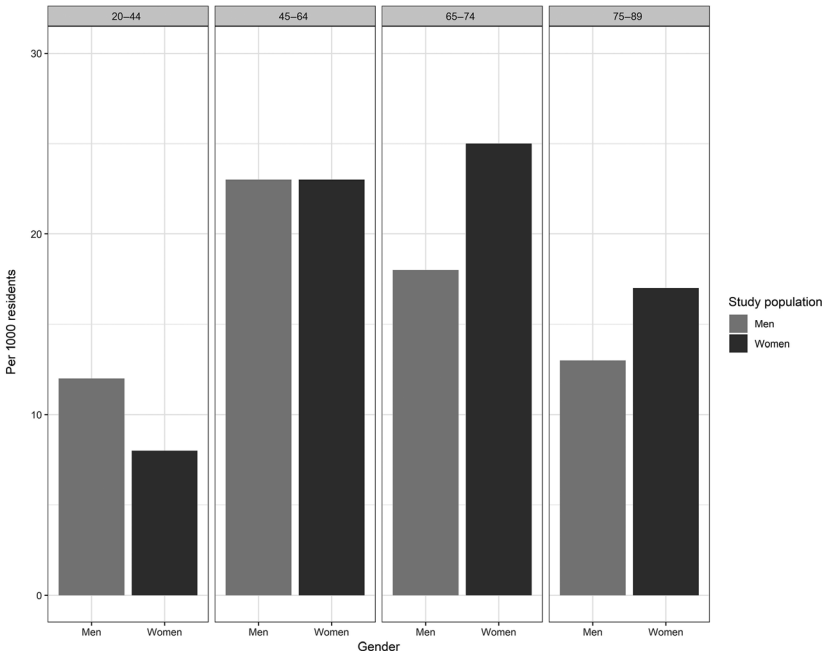

Fig. 1 *Rates (per 1000 residents) of unexplained chest pain discharge as primary diagnosis by age and gender: Norway, 2010–2012.*

Supplemental analyses

In the supplemental analyses of the patient population discharged with chest pain without the prior health exclusions (n = 77 158), the prevalence of a main discharge diagnosis of unexplained chest pain (per 1000 residents) was as high at 29.4 for men aged 45–64 years and as high as 36.2 for women aged 65–74 years (data not presented). A total of 865 patients died within 1-year postdischarge (259 CVD, 606 non-CVD of which 524 were cancer deaths). Total mortality rates (per 1000 person-years) for women and men were similar to that observed for the primary study population ranging as high as 42.7 for women and 68.3 for men aged 75–89 years (Table S2). The SMR analyses found higher total mortality for younger men and women than that expected based upon death rates in the general population (Table 3). Older men, however, had a lower risk of total and non-CVD mortality but higher CVD mortality relative to that expected in the general population. Older women, however, had a lower risk total and non-CVD mortality and a similar CVD mortality than that expected based upon the general population.

Discussion

Relative to the general population, total mortality was 53% higher for male and 45% higher for female patients under 65 years of age where the excess mortality was attributed primarily to non-CVD causes. When SMR analyses included prevalent cases of chest pain, including those with a prior history of CVD or unexplained chest pain, we found no strong evidence of increased CVD mortality 1-year postdischarge relative to that expected in younger men and in women. Older men did have an increased risk of CVD mortality within 1 year postdischarge than that expected based upon the general population. Older women with unexplained chest pain faired similarly in terms of CVD deaths, and better than expected for total and non-CVD mortality.

In a study of general practice patients without pre-existing CHD, men who reported any chest pain had higher 7-year mortality than men not reporting any chest pain. For women, however, no differences were observed in mortality between those reporting and not reporting any chest pain [17]. However, we observed age differences in mortality associated with unexplained chest pain as discharge diagnosis in women: significant excess mortality was found for younger women, but not for women 65–89 years of age who had a lower mortality than expected. We speculate that several underlying factors may contribute to this observation. One possibility is that older women with chest pain are more likely to have CHD than younger

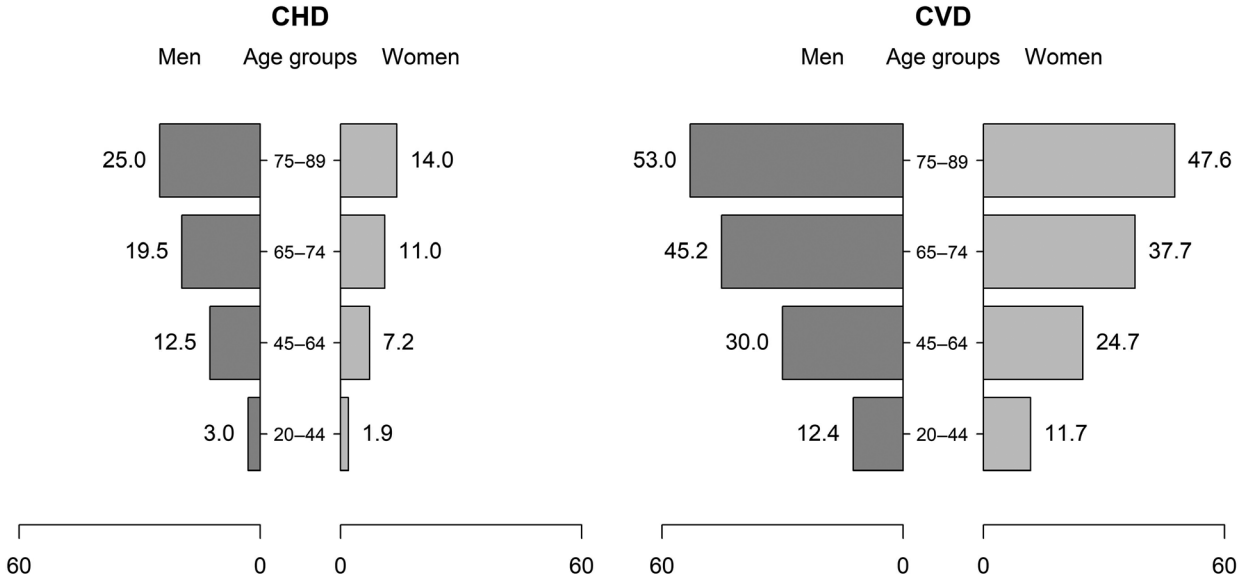

Fig. 2 *Cumulative hazards (%) of incident coronary heart disease (CHD) and cardiovascular disease (CVD) (diagnosis or death) within 1 year following discharge with unexplained chest pain as main diagnosis by age group and gender, Norway 2010–2012.*

women resulting in interventions providing health benefits. Whereas the aetiology underlying chest pain for younger women (as well as younger men) is likely diverse. In fact, at younger ages, we see little difference between men and women with regard to non-CVD deaths and total morality.

The majority of the published literature on chest pain focuses on cardiovascular outcomes, gastro-oesophageal disorders, and underlying psychological distress/anxiety. Our findings of greater non-CVD mortality than expected within the first year of discharge in our primary and supplementary analyses suggests that patients discharged with unexplained chest pain may benefit from greater healthcare coordination between medical disciplines.

Complaints of chest pain provide a considerable burden to healthcare services. We found that patients with an unexplained chest pain discharge diagnosis during 2010–2012 represented up to 2.3% of the general population of men and 2.5% of women in our primary analyses, and up to 2.9% of men and 3.6% of women in selected age groups in our supplementary analyses. Similarly, in 2017, the number of GP contacts for complaints related to chest pain in Norway represented 2%–4% of the general population among those >40 years of age (The Norwegian Directorate of Health, Norwegian Registry for Primary healthcare, Health Information Statistics Dashboard: https://statistikk.helsedirektoratet.no/bi/Dashboard/dbb59004-5ca1-4b16-a734-f16b88d269f7?e=false&vo=viewonly). Also, in the UK, approximately 2% of the general population consult a GP for chest pain [1,18].

Also noteworthy is that there was an approximately 20-year delay in the peak incidence of unexplained chest pain discharge for women compared to men in the current study. The differences in the rates observed between men and women could reflect differences in symptom prevalence and underlying aetiology, healthcare seeking behaviour and referral patterns.

We also identified a high per cent of patients obtaining follow-up diagnostic procedures within 180 days of discharge from an inpatient or outpatient hospital visit. Subsequently, we also found a high cumulative hazard for CHD (primarily nonfatal) within the first year of follow-up: for men and women, respectively, percentages were as high as 25% and 14% for those 75–89 years of age with considerable variation in 1-year CHD and CVD prognosis by age group and sex.

Table 2 *Hazard ratios for incident coronary heart disease, cardiovascular disease, and mortality within the first year following a main discharge diagnosis of incident unexplained chest pain among 20–89 year olds by educational level and gender: Norway 2010–2012 (N = 59 569)*

		Total CHD[a] (n = 4479)		Total CVD[b] (n = 13 648)		CVD mortality (n = 121)		Non CVD mortality (n = 350)	
	N	Cases	HR (95% CI)[c]	Cases	HR (95% CI)[c]	Cases	HR (95% CI)[c]	Cases	HR (95% CI)[c]
Education[d]									
Primary	16 757	1417	1.13 (1.04–1.23)	4170	1.14 (1.09–1.20)	54	1.88 (1.07–3.30)	132	1.50 (1.09–2.06)
Secondary	26 715	2036	1.02 (0.94–1.10)	6306	1.09 (1.04–1.13)	48	1.21 (0.69–2.13)	156	1.21 (0.89–1.65)
Post-secondary	14 455	940	1.0	2862	1.0	16	1.0	55	1.0
Gender									
Women	29 452	1789	1.0	6662	1.0	45	1.0	154	1.0
Men	30 117	2690	1.88 (1.77–2.00)	6986	1.24 (1.20–1.29)	76	2.92 (2.00–4.27)	196	1.87 (1.50–2.32)
Acute care[e]									
No	37 426	2916	1.0	8926	1.0	74	1.0	218	1.0
Yes	22 143	1563	1.05 (1.04–1.05)	4722	1.04 (1.0002–1.08)	47	1.36 (0.94–1.97)	132	1.28 (1.03–1.59)

CHD, coronary heart disease; CI, confidence interval; CVD, cardiovascular disease; HR, hazard ratio.
[a]ICD-10 diagnoses: R072–R074 as main hospital discharge diagnosis.
[b]ICD-10 diagnoses: I20–I25 as any hospital discharge diagnosis or cause of death.
[c]ICD-10 diagnoses: I00–I99 as any hospital discharge diagnosis or cause of death.
[d]Model includes age (years), educational level (primary, secondary, post-secondary), gender, and acute care (no versus yes).
[e]Primary (up to grade 9), Secondary (high school or vocational school), Post-secondary (any college or university), missing value for 2.8%.
[f]Includes acute care patients.

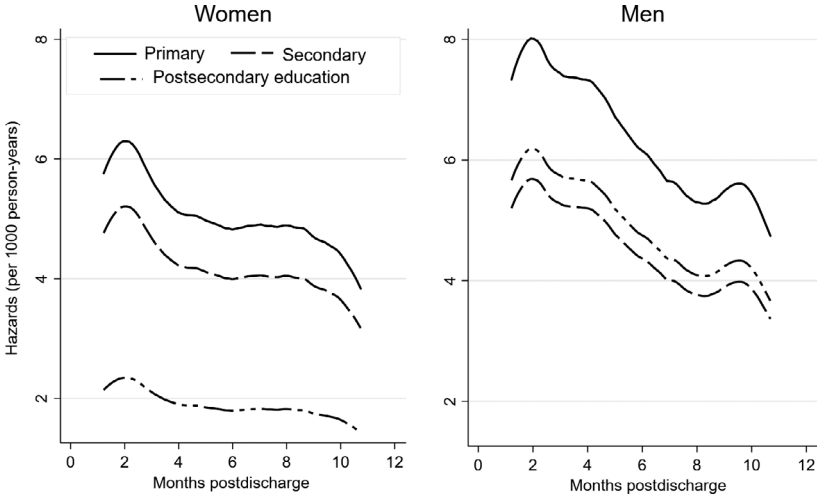

Fig. 3 *Age-adjusted smoothed hazards of total mortality (per 1000 person-years) within 1 year following discharge with unexplained chest pain as main diagnosis by educational level and gender.*

While men compared to women had an 88% greater hazard of CHD diagnoses (or as cause of death), and only a 24% greater hazard of total CVD diagnoses (or as cause of death), they had a nearly threefold greater hazard of 1-year total CVD mortality. These results would suggest that female relative to male patients are being diagnosed with CVD to a greater extent than CHD. The greater CVD mortality among men, however, suggests that men could benefit from greater follow-up postdischarge to identify opportunities for reducing CVD mortality.

Comparisons with the prevailing literature are difficult to make due to differences in study populations, lack of age-stratified analyses, or differences in length of follow-up postdischarge. In Iceland, two to ten per cent of unexplained chest pain patients were diagnosed with CVD within 1 year [19]. In a study of emergency department admissions of acute non-coronary chest pain patients, five per cent of the patients developed an adverse CVD event over the first year [20]. Among patients seen in rapid access chest pain clinics in England, 32% of CHD deaths (an average of 2.6 years from discharge) were to non-cardiac chest pain patients [21]. Additionally, in a GP patient follow-up study in the UK, unexplained chest pain patients had a nearly twofold greater risk of CVD events within 1-year postdischarge, and a 35% increased risk of CVD within 1–3 years of follow-up when compared to patients with an initial diagnosis of noncoronary chest pain [22]. The high per cent developing subsequent CHD and CVD in our study provides additional support for the utility of follow-up diagnostic services for patients discharged with unexplained chest pain diagnosis.

We found stability in the educational differences in mortality by time postdischarge for both men and women. In contrast, in a UK study of patients who attended their GP for chest pain, each quintile increase in socio-economic deprivation score associated with greater incident CHD for women but not men [1]. As the UK and Norway both have national healthcare systems, theoretically there should be no differences in health coverage by socio-economic status. Educational differences likely exist in underlying severity of disease, comorbidities and presence of important risk factors at the time of presentation all of which would contribute to the educational gradient in mortality risks observed. The gender difference observed in the UK and current study may relate to different patterns of underlying risk factors by socio-economic status and gender between the two countries.

Strengths and limitations

A key strength is the national coverage of the data sources of unexplained chest pain as main discharge diagnosis with record linkages to subsequent inpatient or outpatient hospital visits and to the Cause of Death Registry and the National Educational Database. Another strength was the ability to restrict analyses to a low-risk patient population without a prior 2-year history of diagnosed CVD or unexplained chest pain, thereby

Table 3 *Standardized mortality ratios (SMR) of first-year mortality following a hospital discharge diagnosis of unexplained chest pain relative to annual expected deaths based upon the general population: Norway 2010–2012*

	Men		Women	
	O/E	SMR (95% CI)	O/E	SMR (95% CI)
Incident cases[a]				
<65 years				
CVD mortality[b]	23/14.9	1.55 (0.98–2.32)	4/5.2	0.77 (0.21–1.97)
Non-CVD mortality	79/51.7	1.53 (1.21–1.91)	59/38.2	1.55 (1.18–1.99)
Total mortality	102/66.5	1.53 (1.25–1.86)	63/43.3	1.45 (1.12–1.86)
65–89 years				
CVD mortality[b]	53/41.9	1.26 (0.95–1.65)	41/48.8	0.84 (0.60–1.14)
Non-CVD mortality	117/95.3	1.23 (1.02–1.47)	95/116.7	0.81 (0.66–0.99)
Total mortality	170/137.2	1.24 (1.06–1.44)	136/165.5	0.82 (0.69–0.97)
	Men		Women	
	O/E	SMR (95% CI) [c]	O/E	SMR (95% CI) [c]
Prevalent cases[c]				
<65 years				
CVD mortality[b]	32/23.6	1.36 (0.93–1.91)	13/8.0	1.62 (0.86–2.77)
Non-CVD mortality	106/81.0	1.31 (0.93–1.91)	88/58.6	1.50 (1.20–1.85)
Total mortality	138/104.7	1.32 (1.11–1.56)	101/66.65	1.52 (1.23–1.84)
65–89 years				
CVD mortality[b]	116/95.0	1.22 (1.01–1.47)	98/105.1	0.93 (0.76–1.14)
Non-CVD mortality	221/211.0	1.05 (0.09–1.20)	191/239.7	0.80 (0.69–0.92)
Total mortality	337/306.0	1.10 (0.99–1.23)	289/344.7	0.84 (0.74–0.94)

O/E, observed/expected deaths; SMR, standardized mortality ratios; CI, confidence intervals; CVD, cardiovascular disease deaths;
[a]ICD-10 diagnoses: R07.2–R07.4
[b]Patients aged 20–89 years with a main discharge diagnosis of unexplained chest pain 2010–2012 and no prior 2-year history of unexplained chest pain or cardiovascular disease. Excludes patients without a national personal identification number, and patients who had a secondary diagnoses of coronary heart disease (ICD-10: I20–I25) at time of discharge.
[c]CVD, ICD-10 diagnoses I00–I99.
[d]Patients aged 20–89 years with a main discharge diagnosis of unexplained chest pain 2010–2012, regardless of a prior history of unexplained chest pain or cardiovascular disease. Excludes patients without a national personal identification number and patients who had a secondary diagnoses of coronary heart disease (ICD-10: I20–I25) at time of discharge.
[e]SMR calculations of expected deaths based upon the number of deaths by gender and 5-year age strata of the general Norwegian population aged 20–89 years.

enabling evaluation of prognosis in a largely non-CVD patient population. A third strength is the supplemental analyses evaluating all patients regardless of prior history of CVD or unexplained chest pain. Further, the study includes non-CVD mortality as an outcome and the data sources enabled us to compare the patient mortality experience to that of the general population. Limitations of the current study include lack of information on patient contacts in primary care and prescription data. Further, as in most studies based on administrative health registries, we lacked validation of unexplained chest pain as the main diagnosis, and information on individual risk factors such as family history of CHD, blood pressure, body mass index, blood glucose, lipid values and smoking habits. Another limitation involves the under ascertainment of secondary diagnoses precluding the evaluation of their contribution to prognosis. However, the sensitivity and specificity of acute myocardial infarction as discharge diagnosis in the Norwegian Patient Registry are acceptable [23].

Conclusions

While long-term follow-up studies are needed, the 1-year prognosis suggests that patients discharged from hospital with incident unexplained chest pain as the main diagnosis are receiving follow-up diagnostic evaluations but remain an at-risk patient population where age, educational level and gender provide indications of prognosis. Further, given the greater 1-year non-CVD mortality observed, better coordination between medical disciplines in follow-up of unexplained chest pain patients may be worthwhile.

Conflict of interest statement

The authors declare that there is no conflict of interest.

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None.

Author contributions

GE drafted the manuscript. GE and RA conducted analysis, ME developed the overall study design and acquired the data. All authors contributed critically to the revised manuscript and provided final approval of its content. The first and corresponding author had full access to all study data and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Flow chart of study population.

Table S1. Percent of total deaths attributed to cardiovascular disease (CVD) by time intervals within the first year following a hospital discharge diagnosis of unexplained chest pain by gender: Norway 2010–2012 (N = 59 569).

Table S2. First-year mortality rates (per 1000 person-years) following a hospital discharge diagnosis of unexplained chest pain by age group and gender: Norway 2010–2012.